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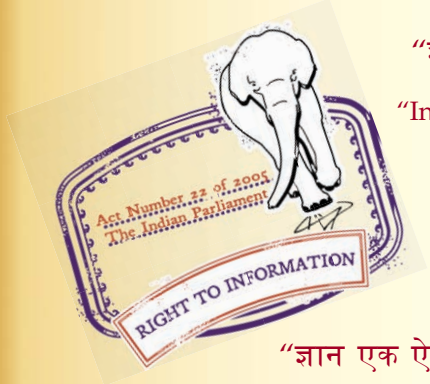

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IS : 5206 - 1983
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Indian Standard

SPECIFICATION FOR COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF STAINLESS STEEL AND OTHER SIMILAR HIGH ALLOY STEELS

(First Revision)

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January 1984

Indian Standard

SPECIFICATION FOR COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF STAINLESS STEEL AND OTHER SIMILAR HIGH ALLOY STEELS

(*First Revision*)

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(*Continued on page* 25)

Indian Standard

SPECIFICATION FOR COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF STAINLESS STEEL AND OTHER SIMILAR HIGH ALLOY STEELS

(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 14 April 1983, after the draft finalized by the Welding General Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1969. In this revision the following modifications have been affected :

a) The range of electrodes has been enlarged, and

b) The classification system and chemical composition have been based on ISO 3581-1976.

0.3 In the formulation of this standard, assistance has been derived from the following publications :

BS 2926 : 1970 Chromium-nickel austenitic steel electrodes for manual metal arc welding. British Standards Institution.

AWS A5.4-69 Specification for corrosion-resisting chromium and chromium-nickel steel covered welding electrodes. American Welding Society.

ISO 3581-1976 Covered electrodes for manual arc welding of stainless and other similar high alloy steels — Code of symbols for identification. International Organization for Standardization.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers the requirements for covered electrodes for manual

*Rules for rounding off numerical values (*revised*).

TABLE 1 CHEMICAL COMPOSITION OF ALL-WELD METAL

(*Clauses* 1.1, 4.3 *and* 9.1)

CLASSIFICATION	PERCENT									
	CARBON*	CHROMIUM	NICKEL	MOLY-BDENUM	NEOBIUM AND TANTALUM	MANGA-NESE	SILI-CON	PHOS-PHORUS	SUL-PHUR	COPPER
E 13	0·12	11-14	—	0·5	—	1·0	0 90	0·04	0·03	—
E 13.4	0·07	12-15	3-5	0·40-0·70	—	1·0	9·90	0·04	0·03	—
E 17	0·10	15-18	—	0·5	—	1·0	0·90	0·04	0·03	—
E17.4	0·10	15-18	3-5	0·9-1·25	—	1·0	0·90	0·04	0·03	—
E 19.9	0.08	18-21	8-11	0·5	—	2·5	0·90	0·04	0·03	—
E 19.9 L	0·04	18-21	8-11	0·5	—	2·5	0·90	0·04	0·03	—
E 19.9 Nb	0·08	18-21	8-11	0·5	8×C *Min* to† 1·2 *Max*	2·5	0·90	0·04	0·03	—
E 19.9 LNb	0.04	18-21	8-11	0·5	8×C *Min* to† 1·2 *Max*	2·5	0·90	0·04	0·03	—
E 19.12.2	0·08	17-20	11-14	2-2·5	—	2·5	0·90	0·04	0·03	—
E 19.12.2 L	0·04	17-20	11-14	2-2·5	—	2·5	0·90	0·04	0·03	—
E 19.12.2 Nb	0·08	17-20	11-14	2-2·5	8×C *Min* to 1·2 *Max*	2·5	0·90	0·04	0 03	—
E 19.12.3	0·08	17-20	10-14	2·5-3·5	—	2·5	0·90	0·04	0·03	—
E 19.12.3 L	0·04	17-20	10-14	2·5-3·5	—	2·5	0 90	0·04	0.03	—
E 19.12.3 Nb	0·08	17-20	10-14	2·5-3·5	8×C *Min* to 1.2 *Max*	2·5	0·90	0·04	0·03	—
E 23.12	0·15	22-26	11-15	0·5	—	2·5	0·90	0·04	0·03	—
E 23.12 L	0·04	22-26	11-15	0·5	—	2·5	0·90	0·04	0·03	—
E 23.12 Nb	0·12	22-25	11-15	0·5	8×C *Min* to 1·2 *Max*	2·5	0·90	0·04	0·03	—
E 23.12.2	0·12	22.25	11-15	2-3	—	2·5	0·90	0·04	0·03	—
E 16.8.2	0·10	14·5-16·5	7·5-9·5	1-2	—	2·5	0·50	0·03	0·03	—

E 18.8 Mn	0·20	17-20	7-10	0·5	—	5-8	0·90	0·04	0·03	—
E 18.15.3 L	0·04	16·5-19·5	13-16	2·5-3·5	—	2·5	0·90	0·04	0·03	—
E 25.20	0.20	24-28	18-22	0·5	—	2·5	0·75	0·03	0·03	—
E 25.20 L	0·04	24-28	18-22	0·5	—	2·5	0·75	3·03	0·03	—
E 25.20 Nb	0·12	24-28	18-22	0·5	8×C *Min* to 1·2 *Max*	2·5	0·75	0·03	0·03	—
E 25.20.2	0·12	25-28	20-22	2-3	—	2·5	0·75	0·03	0·03	—
E 25.20 C	0·25-0·45	24-28	18-22	0·5	—	2·5	0·90	0·03	0·03	—
E 25.25.2 Nb	0·10	24-27	24-26	2-2·5	8×C *Min* to 1·2 *Max*	2·5	0·90	0·03	0·03	—
E 20.25.5 LCu	0·04	19-22	24-26	4-6	—	2·5	0·90	0·03	0·03	1-3
E 23.27.3 LCuNb	0·04	21-25	25-29	2·5-4·5	8×C *Min* to 1·2 *Max*	2·5	0·90	0·03	0·03	2·5-3·5
E 25.4	0·15	24-27	4-6	0·5	—	2·5	0·90	0·04	0·03	—
E 29.9	0·15	28-32	8-12	0·5	—	2·5	0·90	0·04	0·03	—
E 18.36	0·25	14-19	33-38	0·5	—	2·5	0·90	0·04	0·03	—

NOTE 1 — Analysis shall be made for the elements for which specific values are shown in the table. If however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements, except iron, is not present in excess of 0·7 percent.

NOTE 2 — Single values shown are maximum percentages except where otherwise specified.

*Carbon shall be analysed to the nearest 0·01 percent.

†Chromium shall be 1·9×Ni *Min* when specified.

metal arc welding of stainless and other similar high alloy steels. The range of electrodes covered, in this standard is given in Table 1.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions laid down in IS : 812-1957* shall apply.

3. SUPPLY OF MATERIALS

3.1 General requirements relating to supply of electrodes shall be as laid down in IS : 1387-1967†.

4. CLASSIFICATION

4.1 The electrodes are classified on the basis of chemical analysis of weld metal, type of covering, metal recovery, welding characteristics of the electrode and also the special characteristics of the electrode. The classification is divided into six parts.

4.1.1 First part is a symbol for the type of product.

4.1.2 The second part is a symbol for the chemical composition of the deposited weld metal.

4.1.3 The third part is a symbol for the type of covering.

4.1.4 The fourth part is a symbol for metal recovery.

4.1.5 The fifth part is a symbol for the welding characteristics of the electrode.

4.1.6 The sixth part is a symbol 'X' indicating that the electrode has some special properties (synthetic, fully austenitic, etc). This part is always compulsory when the electrode has special feature. In this case the symbols for metal recovery (**4.1.4**) and for welding characteristics (**4.1.5**) are also compulsory.

4.2 First Part — Symbol for the Product — The prefix letter 'E' shall indicate the suitability of the covered electrode for manual metal arc welding.

4.3 Second Part — Symbol for Chemical Composition — The symbols used for the chemical composition of the deposited weld metal are given in Table 1. (In Appendix A is given a comparison of classification in American, British, German, Japanese and ISO Standards.)

4.4 Third Part — Symbol for Type of Covering — The type of covering is symbolized by a letter as follows:

a) B for basic,
b) R for rutile, and
c) S for other types.

*Glossary of terms relating to welding and cutting of metals.

†General requirements for the supply of metallurgical meterials (*first revision*).

4.4.1 *Basic (B)* — Electrodes of the basic type have a rather thick covering containing considerable quantities of calcium or other basic carbonates together with fluorspar or other fluor compositions. The slag is very fluid and rises quickly to the surface of the weld. Slag inclusions are therefore not likely to occur. After solidification, the slag generally has a brown to dark-brown colour and a glossy appearance. It is, except for root-passes, easy to detach. Basic electrodes give a medium penetration and they can, as a rule, be used for welding in all positions as well as for pipe welding. Basic electrodes should be welded with a short arc in order to give good quality welds.

When manufactured, the basic electrodes are baked at a temperature sufficient to result in low water content of the covering. In order to avoid porosity, basic electrodes should be stored in such a manner as to prevent absorption of moisture and be re-dried before use according to the recommendations of the manufacturer.

Stainless steel electrodes with basic coating are particularly used for the welding of thick plates, highly restrained joints and joints in vertical and overhead positions.

4.4.2 *Rutile (R)* — The covering of stainless steel electrodes of this type contains large amounts of rutile or components derived from titanium dioxide, oxides may include basic components. The electrodes are easy to ignite, have a stable arc and low spatter losses. They are easy to weld in all positions and slag detachability and bead appearance are good. The deposited weld metal quality is also good.

When manufactured, stainless steel electrodes with rutile covering are generally baked at high temperatures. In order to avoid porosity they should be stored under dry conditions or if they have absorbed moisture, be redried before use according to the recommendations of the manufacturer.

4.4.3 *Other Types (S)* — This symbol is used for electrodes that cannot be defined as basic or rutile ones.

4.5 Fourth Part — Symbol for Metal Recovery — If the recovery is less than 110 percent no symbol is used. The higher values found by the method for determining the recovery, rounded to the nearest multiple of 10, are used as symbol for metal recovery, for example, 110, 120, 130, 140, 150, etc. For the method of determining the recovery of electrode *see* Appendix D of IS : 815-1974*.

4.6 Fifth Part — Symbols for Welding Characteristics

4.6.0 — The welding characteristics shall be symbolized by a two digit number. The first digit indicates the welding positions for which the electrode is recommended and the second digit indicates the welding current conditions.

*Classification and coding of covered electrodes for metal arc welding of structural steels (*second revision*).

4.6.1 The general welding positions for which the electrode is recommended are symbolized by a digit, as follows:

Digit	*Positions*
1	All positions
2	All positions except vertical downward
3	Flat butt weld, flat fillet weld, horizontal/vertical fillet weld
4	Flat butt weld, flat fillet weld
5	Same as 3 and recommended for vertical downward.

NOTE — Electrodes covered in this standard are not normally used in the vertical downward position.

4.6.2 The welding current and open circuit voltage are symbolized by a digit corresponding to the characteristics of the welding equipment required in order to ensure working conditions free of incidents such as instability or interruptions of the arc.

The open circuit voltage necessary for striking the arc varies according to the diameter of the electrode. A reference diameter is required for symbolization. Table 2 applies to electrode diameters greater than or equal to 2·5 mm. If electrodes of smaller diameter are used, a higher voltage may be necessary.

The frequency of the alternating current is assumed to be 50 or 60 Hz. The open-circuit voltage necessary when electrodes are used on direct current is closely related to the dynamic characteristics of the welding power source. Consequently no indication of the minimum open-circuit voltage for direct current can be given.

TABLE 2 CURRENT CONDITIONS

SYMBOL	DIRECT CURRENT, RECOMMENDED POLARITY*	ALTERNATING CURRENT, MINIMUM OPEN-CIRCUIT VOLTAGE, *V*
(1)	(2)	(3)
0†	+	—
1	+ or —	50
2	—	50
3	+	50
4	+ or —	70
5	—	70
6	+	70
7	+ or —	90
8	—	90
9	+	90

*Symbol reserved for electrodes used exclusively on direct current.
†Positive polarity +, negative polarity—.

4.7 Symbol for Special Properties

4.7.1 The symbol 'X' indicates that the electrode has one or more special properties. Synthetic electrodes, for example, could be characterized in this way. There are also other examples. Normally, austenitic deposited weld metals of the 19.12.2 L type have a ferrite content of 3 to 7 percent. For special purpose, fully austenitic or low ferrite variants are also developed. Such electrodes could be marked by the symbol 'X'.

4.7.2 The special properties should not, however, be codified. The symbol 'X' only recommends the user to study the electrode manufacturer's catalogue for further information.

4.8 Instructions for Use of Classification Symbols — In order to promote the use of this identification, the codification is split into sections.

4.8.1 *Compulsory Section* — This section includes the symbols for the type of product, for the chemical composition of the deposited weld metal and for the type of covering, and a symbol 'X' indicating that the electrode has some special properties, that is, the symbols defined in **4.2, 4.3, 4.4** and **4.7.**

4.8.2 *Optional Section* — This section includes the symbols for the metal recovery and for the welding characteristics of the electrode.

4.8.3 *Examples of Classification*

Example 1 :

Covered electrode for manual electric arc welding, having a rutile covering and depositing weld metal of the following chemical analysis:

Constituent	*Percent*	*Constituent*	*Percent*
C	0·8 *Max*	Si	0·9 *Max*
Cr	18 to 21	S	0·03 *Max*
Ni	8 to 11	P	0·04 *Max*
Mn	2·5 *Max*		

It may be used for welding in all positions. To be connected on direct current to the positive pole; on alternating current welding, requiring an open-circuit voltage of 70 V. Has metal recovery of 120 percent.

The complete codification for the electrode will be:

E 19.9 R 120 16

and the compulsory part will be:

E 19.9 R

Example 2 :

Covered electrode for manual electric arc welding, having a basic covering and depositing weld metal having the following chemical analysis:

Constituent	*Percent*	*Constituent*	*Percent*
C	0·04 *Max*	Si	0·9 *Max*
Cr	17 to 20	Mn	2·5 *Max*
Ni	11 to 14	S	0·03 *Max*
Mo	2·0 to 2·5	P	0·04 *Max*

It may be used for welding in all positions except, vertical downward. To be connected on direct current welding to the positive pole; on alternating current requiring on open circuit voltage of 70 V. Refer to manufacturer's recommendations for the special characteristics of the electrodes.

The complete codification for the electrode will be:

E 19.12.2.L R 14 X

and the compulsory part will be:

E 19.12.2.L R X

5. SIZES

5.1 The sizes of the electrodes shall be designated by the diameter of the core wire in millimetres. The designation and size of the electrodes shall be as given below:

Designation of Electrode Size	*Diameter of the Core Wire* mm
1·6	1·60
2	2·00
2·5	2·50
3·15	3·15
4	4·00
5	5·00
6·3	6·30
8	8·00

5.2 Tolerance on Size — The tolerance on the specified diameter of the core wire of the electrodes shall be $\frac{+0·00}{-0·05}$ mm.

5.3 Length — The length of various sizes of electrodes shall be as given below:

Size Designation	*Length* mm	*Size Designation*	*Length* mm
1·6	(150) (*see* Note 1)	2·5 (*see* Note 2)	250
	200	to	300
	250	5	350
	200	Above	350
	250		400
	300		450
	350		

NOTE 1 — The value in bracket should be avoided as far as possible.

NOTE 2 — When the electrode is of composite type of size designation 2·5 the length may be 450 mm by agreement between the manufacturer and the purchaser.

5.4 Tolerance of Length — The tolerance on the length of individual electrodes over normal length shall be ± 3 mm.

6. GENERAL REQUIREMENTS

6.1 The contact end of the electrodes shall be bare and clean to a length of 20 to 30 mm.

6.2 The arc striking end of the electrodes shall be sufficiently bare to permit easy striking of the arc. The distance from the arc and to the first point where the full cross-section of the covering prevails, shall not exceed the diameter of the core wire, subject to a maximum length of 2·5 mm.

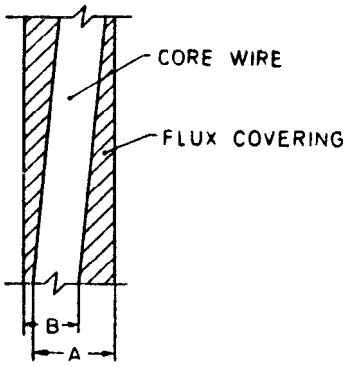
6.3 Covering

6.3.1 The flux covering shall comply with the following requirements:

a) *Strength* — The covering shall be sufficiently strong to withstand without damage normal conditions of handling storage and use.

b) *Uniformity* — The covering shall be uniform in outside diameter and thickness. The tolerance permitted for uniformity of covering shall be such that the maximum core plus one covering dimension (*see* Fig. 1) shall not exceed the minimum core plus one covering dimension by more than three percent of the mean of two dimensions.

6.3.2 The covering shall fuse or burn evenly or both.



$$A - B \not> \frac{3}{100}\left(\frac{A+B}{2}\right)$$

A = Core-plus-one maximum covering dimension.

B = Core-plus-one minimum covering dimension.

FIG. 1 PERMISSIBLE TOLERANCE FOR FLUX COVERING

7. SPECIFIC REQUIREMENTS AND TESTS

7.1 For assessing the mechanical properties of the deposited weld metal, the usability of an electrode for a particular welding position, the electrodes shall be subjected to the following tests:

a) Initial tests,
b) Periodic check tests, and
c) Production control tests.

7.2 Initial Tests — These are qualification or proving tests for a particular type of electrode manufactured with certain qualities of basic material and under certain production conditions. Each type or modified type of electrode shall be subjected to the initial tests and it shall be implicit in the manufacturer's certificate that the electrodes certified by him to conform to any one classification, satisfy all test requirements prescribed for initial tests for that particular classification.

7.2.1 The initial tests specified in Table 3 shall be carried out by the methods given in **8.**

7.3 Periodic Check Tests — These comprise of a few of the tests selected from among the initial tests and are meant to be repeated at intervals to provide evidence that the electrodes currently produced possess the properties proved in the initial tests. Such tests shall be conducted at least once a year. However, these check tests shall not apply to the electrodes not manufactured during that period.

7.3.1 The periodic check tests for electrodes shall comprise of the following:

a) Chemical analysis as specified in **8.1**, and

b) Fillet weld tests as specified in **8.3**.

7.4 Production Control — By means of a suitable system of control, the manufacturer shall satisfy himself that the composition and quality of all the electrodes currently produced are similar to those of the electrodes subjected to the initial tests (*see* 7.2). He shall ensure that the results of production control tests and the date of manufacture is traced from the batch number or the relevant details, or both.

NOTE — For this purpose, a batch is defined as being of the same dry mix, the same cast number and the same size of wire.

7.4.1 The manufacturer on request shall make available to the approving and the certifying authorities the records maintained for production control for ensuring that the composition and quality of all the electrodes currently produced are similar to those electrodes subject to initial and periodic check tests.

7.5 Additional Tests — Subject to the agreement with the manufacturer, the purchaser may request for additional tests to be made or certificates to be provided for each batch of electrodes supplied. If so, the tests and batch definitions shall be agreed to between the purchaser and the manufacturer.

TABLE 3 SUMMARY OF INITIAL TESTS AND REQUIREMENTS

(*Clauses* 7.2.1 *and* 8.3.2)

ELECTRODE SIZE	POSITION OF WELDING		
	Chemical Analysis	All-weld Tensile Test	Fillet Weld Test
1·6, 2, 2·5	Flat	Not required	Not required
3·15, 4	Flat	Flat	Vertical and overhead
5 and above	Flat	Flat	Horizontal and vertical

8. METHODS OF TEST

8.1 Chemical Analysis

8.1.1 The sample for chemical analysis shall be taken either from the fractured parallel portion of the all-weld tensile test specimen or from a weld pad.

8.1.2 When a pad is to be used, weld metal shall be deposited in the flat positions on to parent metal of carbon steel having a maximum carbon content of 0·25 percent or of steel similar in composition to that deposited by the electrode.

8.1.3 The range of current used shall be as recommended by the manufacturer, excepting that, when both ac and dc are specified, only one type of current need be used. The pads shall be deposited in layers, each pass of which shall measure in width one and a half to two and a half times the diameter of the core wire. After each layer, the pad shall be immersed in water for 30 seconds. The arc length shall be as short as practicable, the maximum arc voltage and average current shall be as recommended by the manufacturer.

8.1.4 All weld pads shall conform to the dimensions given in Table 4. The top surface of the pad shall be removed and discarded. The required quantity of sample shall be removed for analysis by machining, drilling, or milling in such a manner that no metal shall be removed from the pad closer to the base metal than specified in Table 4.

NOTE — Pads which are hard for machining may be given an annealing heat-treatment (*see* Table 6).

TABLE 4 WELD PAD DIMENSIONS

ELECTRODE SIZE	MINIMUM PAD SIZE	MINIMUM DISTANCE OF SAMPLE FROM SURFACE OF BASE PLATE
	mm × mm × mm	mm
1·6, 2, 2·5	30 × 30 × 13	8
3·15, 4, 5	40 × 40 × 16	10
6·3 and above	55 × 55 × 20	12

8.1.5 The sample shall then be analysed in accordance with the methods given in relevant parts of IS : 228*. For elements not covered in this standard the method of analysis shall be in accordance with the accepted trade and technological practices subject to mutual agreement between the supplier and the purchaser.

8.2 All-Weld Metal Tensile Test — The parent metal for the plates used in preparing a test piece shall be carbon steel conforming to IS : 226-1975†, IS : 2002-1962‡ or IS : 2062-1980§ or steel similar in composition to that deposited by the electrode. If carbon steel is used the fusion faces and backing strip shall be clad with at least three layers of weld metal deposited by the electrodes of the type under test, the thickness of the cladding being not less than 3 mm.

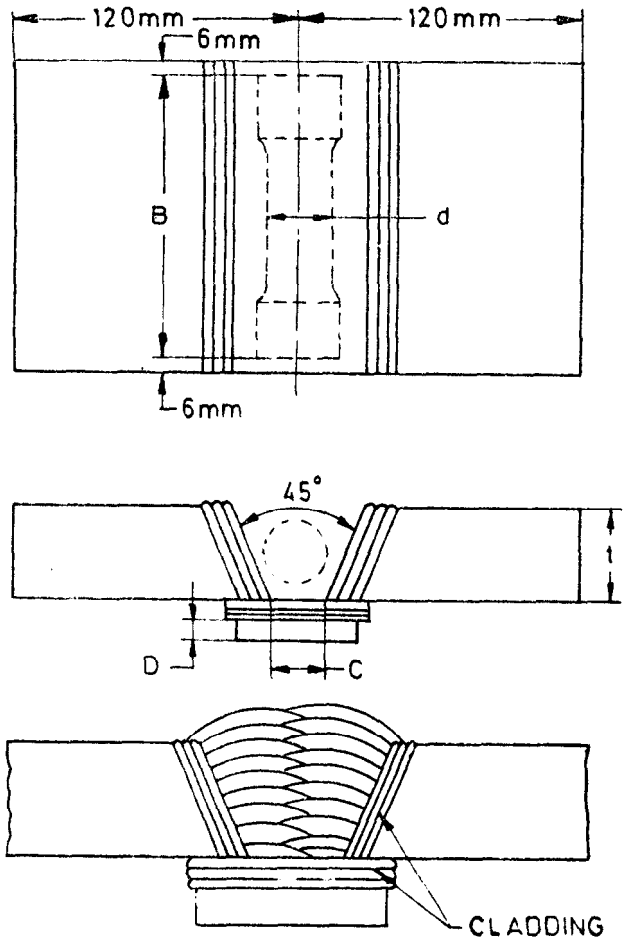
8.2.1 The dimensions of the test piece shall be as shown in Fig. 2 in conjunction with Table 5. The plates shall not be restrained during welding but may be pre-set so that the plates are approximately flat after welding has been completed. Test plates shall not be straightened after welding.

*Methods of chemical analysis of steels (*issued in parts*).
†Specification for structural steel (standard quality) (*fifth revision*).
‡Specification for steel plates for boilers.
§Specification for structural steel (fusion welding quality) (*second revision*).

TABLE 5 DIMENSIONS OF TEST PIECE AND ALL-WELD TENSILE TEST SPECIMEN

(*Clauses* 8.2.1, 8.2.4 and *Fig.* 2)

ELECTRODE SIZE	THICKNESS OF PLATE	DIMENSIONS			
	t	*d*	*B*	*C*	*D*
	mm	mm	mm	mm	mm
3·15	12	5·7	75	6	5
Larger than 3·15	20	10·76	125	12	6



NOTE — These drawings are diagrammatic only.

FIG. 2 TEST PIECE AND ALL-WELD TENSILE TEST SPECIMEN

8.2.2 The weld metal shall be deposited in the flat position in single or multi-run layers and the directions of deposition of each layer shall be alternately from each end of the test piece. When weaving is used the width shall be not more than three times the core wire diameter. Each run or layer shall be not less than 2 mm and not more than 4 mm thick. The interpass temperature for electrodes of classifications E 13, E 13.4, E 17 and E 17.4 shall be controlled between 150-260°C and for other electrodes between 20-150°C. Cooling for interpass temperature control shall be in air.

8.2.3 When welding has been completed, test pieces prepared using electrodes of classification E 13, E 13.4, E 17 and E 17.4 shall be heat treated in accordance with the requirements of Table 6. Test pieces using other electrodes shall be allowed to cool in still air on completion of welding.

TABLE 6 POST-WELD HEAT TREATMENT FOR ALL-WELD TEST PIECES
(Clauses 8.1.4 and 8.2.3)

ELECTRODE CLASSIFICATION	POST-WELD HEAT TREATMENT*
E 13	840-870°C for 2 hours, furnace cool to 600°C at cooling rate of 55°C/h (*Max*), then air cool
E 13.4	595 to 620°C for 1 hour, then air cool
E 17	760-790°C for 4 hours; furnace cool to 600°C at cooling rate of 55°C/h (*Max*), then air cool
E 17.4	580°C for 8 hours; furnace cool to 300°C, then air cool

*Post-weld heat treatment differs from normally adopted conditions for production work.

8.2.4 The tensile test specimen shall be machined from the test piece to the dimensions shown in Fig. 2 in conjunction with Table 5, care being taken that the longitudinal axis of the test specimen coincides with the centre line of the weld.

8.2.5 The tensile test shall be carried out in accordance with IS : 1608-1972*.

8.3 Fillet Weld Test — The parent metal for the plates used in preparing a test piece shall be steel which is broadly similar in compositions to that deposited by the electrode.

8.3.1 The dimensions of the test piece shall be as shown in Fig. 3 read in conjunction with Table 7. In preparing the two plates forming the test assembly, the web plate shall have one edge machined throughout its length so that when it is set upon the base plate, which shall be straight and smooth, there will be intimate contact for the entire length of the joint.

*Method for tensile testing of steel products (*first revision*).

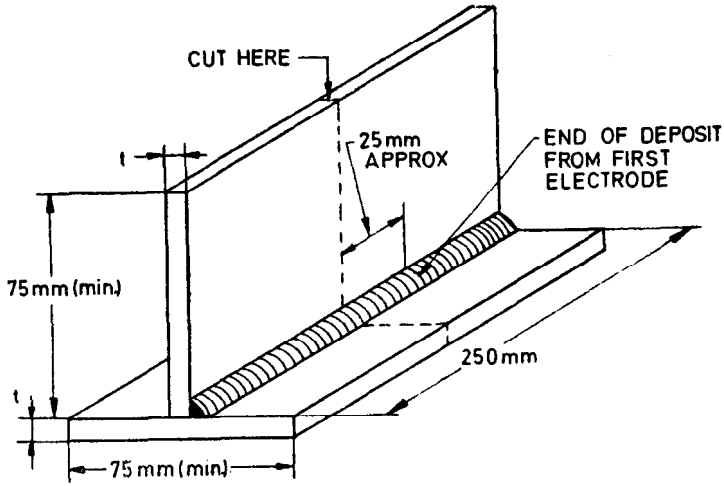


FIG. 3 FILLET WELD TEST PIECE

8.3.2 A single run fillet weld having leg lengths equal to within 1·5 mm shall be deposited on one side of the joint in the appropriate welding position or positions as specified in Table 3. When welding in the vertical position the method used shall be upward. The first electrode used shall be consumed for its entire length except for the last 50 mm and a new electrode shall then be used to complete the full length of the weld.

8.3.3 At a location approximately 25 mm back from the stop-start position, the test piece shall be cut and the exposed faces shall be prepared and etched (*see* Appendix B).

TABLE 7 MAXIMUM SIZE OF FILLET WELD
(*Clauses* 8.3.1 *and* 9.3 2)

ELECTRODE SIZE	THICKNESS OF PLATE	POSITION OF WELDING	MAXIMUM FILLET WELD LEG LENGTH
(1)	(2)	(3)	(4)
mm	mm		mm
3·15	6·0	Vertical	6·0
		Overhead	5·0
4	6·0	Vertical	8·0
		Horizontal-Vertical and Overhead	6·0
5·0	10·0	Horizontal-Vertical	8·0
6·3	10·0	Horizontal-Vertical	8·0

9. TEST REQUIREMENTS

9.1 Chemical Analysis — The material obtained by the method described in **8.1** shall show on analysis a chemical composition that complies with Table 1.

9.2 All-Weld Test — The mechanical properties obtained from the test specimen prepared as described in **8.2** shall be in accordance with those specified in Table 8.

TABLE 8 REQUIREMENTS FOR ALL-WELD METAL TENSILE TEST

CLASSIFICATION (SYMBOL)	TENSILE STRENGTH *Min*	ELONGATION ($L = 5{\cdot}65\sqrt{A}$) *Min*
	MP	Percent
E 13	480	20
E 13.4	760	15
E 17	480	20
E 17.4	480	20
E 19.9	560	30
E 19.9 L	510	30
E 19.9 Nb	560	26
E 19.9 LNb	560	26
E 19.12.2	510	26
E 19.12.2 L	490	26
E 19.12.2 Nb	560	22
E 19.12.3	560	26
E 19.12.3 L	560	26
E 19.12.3 Nb	560	22
E 23.12	560	26
E 23.12 L	560	26
E 23.12 Nb	560	26
E 23.12.2	560	26
E 16.18.2	560	30
E 18.8 Mn	560	26
E 18.15.3 L	510	26
E 25.20	560	26
E 25.20 L	560	26
E 25.20 Nb	560	22
E 25.20.2	560	26
E 25.20 C	620	10
E 25.25.2 Nb	560	22
E 20.25.5 LCu	560	22
E 23.27.3 LCuNb	560	22
E 25.4	660	15
E 29.9	660	19
E 18.36	510	22

9.3 Fillet Weld Test

9.3.1 The prepared and etched faces of the weld and parent metal from the test piece, obtained by the method described in **8.3** shall be free from cracks and the weld shall be reasonably free from undercutting, overlap, porosity and slag inclusions.

9.3.2 The fillet weld leg lengths and convexity shall be determined by actual measurement to the nearest 0·5 mm on a section laid out with scribed lines as shown in Fig. 4, the difference in leg lengths being not more than 1·5 mm. For the purpose of this standard the smaller leg length shall be used. The fillet weld leg length shall be in accordance with the requirements of Table 7 and the convexity shall not exceed the value determined from Fig. 4.

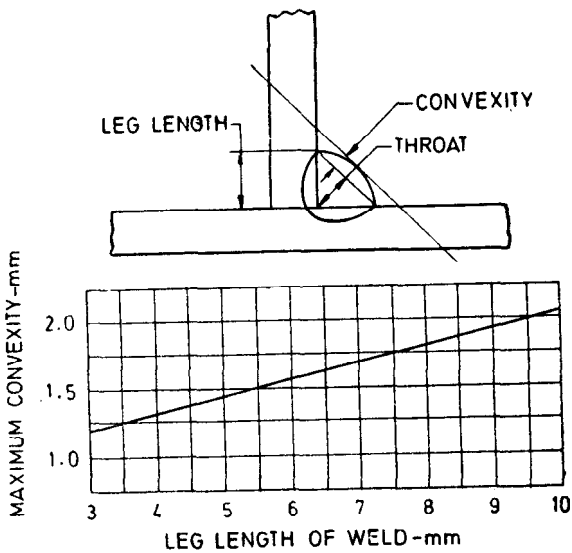


FIG. 4 DIMENSIONS OF FILLET WELD

10. RETESTS

10.1 Where any test specimen fails to satisfy the test requirements, two further test specimens shall be prepared (using electrodes from the same batch) and submitted to the test in which the requirements were not fulfilled. The electrodes shall be deemed as not complying with this standard unless the test on both the additional specimens are satisfactory.

11. PACKING AND STORAGE

11.1 The net mass of an individual bundle or box of electrodes for manual operation shall not exceed 7 kg.

11.2 Electrodes shall be suitably packed to guard against damage during transportation. The packing shall be suitable to ensure that under normal storage, the electrode shall, for a period of at least six months after the despatch from the manufacturer's stores, be capable of giving results in accordance with the provisions of this specification. If the flux covering is of a type requiring special protection during storage, the details of such special protection shall be furnished by the manufacturer and reference to this shall be included in the markings on the bundle or box of electrodes. The electrodes shall be stored in a dry atmosphere.

11.3 Each bundle or package shall contain the manufacturer's certificate guaranteeing that the electrodes therein comply with the physical and performance requirements of this standard.

11.3.1 If marking on the bundle includes ISI Certification Mark (*see* **13.1.1**), the manufacturer's certificate need not be included.

12. TEST RESULTS

12.1 If required by the purchaser, in evidence that the electrodes supplied comply with the requirements of this specification, the manufacturer shall produce the results of the most recent periodic check tests carried out within the preceding 12 months on electrodes representative of the electrodes supplied.

12.2 If required, the manufacturer shall supply a test certificate giving the results of the initial tests carried out on the type of electrode supplied (*see also* **7.2**).

13. MARKING

13.1 Each bundle or package of electrodes shall be clearly marked with the following (*see also* **11.2, 11.3** and **11.3.1**):

a) Code designation;
b) Name of the manufacturer;
c) Trade designation of electrodes;
d) Size;
e) Batch number (*see* **7.4**);
f) Recommended current range; and
g) Recommendations for special storage condition, if necessary (*see* **11.2**).

13.1.1 *BIS Certification Marking*

The bundle or package of electrodes may also be marked with the Standard Mark.

13.2 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act,* 1986 and the rules and regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

APPENDIX A

(*Clause* 4.3)

TABLE 9 COMPARISON OF INDIAN AND OVERSEAS STANDARDS FOR CLASSIFICATION OF COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF STAINLESS STEEL AND SIMILAR HIGH ALLOY STEELS

IS Classification (Symbol)	AWS A 5.4-69	BS 2926-1970	DIN 8556	JIS Z 3221-1968	ISO 3581-1976
(1)	(2)	(3)	(4)	(5)	(6)
E 13	E 410	E 13	E 13	D 410	E 13
E 13.4	—	—	E 13.4	—	E 13.4
E 17	E 430	E 17	E 17	D 430	E 17
E 17.4	—	—	—	—	—
E 19.9	E 308	E 19.9	E 19.9	D 308	E 19.9
E 19.9 L	E 308 L	E 19.9 L	E 19.9 nC	D 308 L	E 19.9 L
E 19.9 Nb	E 347	E 19.9 Nb	E 19.9 Nb	D 347	E 19.9 Nb
E 19.9 LNb	—	—	—	—	E 19.9 LNb
E 19.12.2	E 316	—	—	D 316	E 19.12.2
E 19.12.2 L	E 316 L	—	—	D 316 L	E 19.12.2 L
E 19.12.2 Nb	E 318	—	—	—	E 19.12.2 Nb
E 19.12.3	—	E 19.12.3	E 19.12.3	—	E 19.12.3
E 19.12.3 L	—	E 19.12.3 L	E 19.12.3 NC	—	E 19.12.3 L
F 19.12.3 Nb	—	E 19.12.3 Nb	E 19.12.3 Nb	—	E 19.12.3 Nb
E 23.12	E 309	E 23.12	—	D 309	E 23.12
E 23.12 L	—	—	E 23.12 nC	—	E 23.12 L
E 23.12 Nb	E 309 Cb	E 23.12 Nb	E 23.12 Nb	—	E 23.12 Nb
E 23.12.2	E 309 Mo	E 23.12.2	—	D 309 Mo	E 23.12 L
E 16.8.2	E 16.8.2	—	—	—	E 16.8.2
E 18.8 Mn	—	—	E 18.8 Mn6	—	E 18.8 Mn
E 18.15.3 L	—	—	E 18.15.3 nC	—	E 18.15.3 L

E 25.20	E 310	E 25.20	E 25.20	D 310	E 25.20
E 25.20 L	—	—	—	—	E 25.20 L
E 25.20 Nb	E 310 Cb	E 25.20 Nb	—	—	E 25.20 Nb
E 25.20.2	E 310 Mo	—	—	—	E 25.20 2
E 25.20 C	—	E 25.20 H	—	—	E 25.20 C
E 25.25.2 Nb	—	—	E 25.25.2 Nb	—	E 25.25.2 Nb
E 20.25.5 LCu	—	—	—	—	E 25.25.5 LCu
E 23.27.3 LCu Nb	—	—	—	—	E 23.27.3 L Cu Nb
E 25.4	—	—	E 25.4	—	E 25.4
E 29.9	E 312	—	—	—	E 29.9
E 18.36	E 330	—	E 18.36	—	E 18.36

APPENDIX B

(*Clause* 8.3.3)

RECOMMENDED METHOD OF PREPARING ETCHED SPECIMENS

B-1. This method of preparing etched specimens is suggested for convenience and is in no way intended to be a rigid requirement of this specification.

B-1.1 Preparation of Surface for Etching — The surface should be filed with a coarse file until all deep marks are removed. It should be filed at right angles to the original coarse file marks with a smooth file. The smooth filed surface should be polished with successively finer grades of emery paper, direction of polishing being at right angles to the marks made by the previous paper in each case, polishing being continued until the scratches of the previous paper have been removed before proceeding to the next finer grade. This procedure is indicated in order to show the means by which a first class finish may be obtained.

B-1.2 Etching for Macro-Examination — In general for steel, an '0' emery finish will be smooth enough for a satisfactory etch to be obtained for macro-examination. Some of the typical etching solutions are as follows :

Composition of Etching Solution	*Parts by Volume*
Concentrated hydrochloric acid	4
Concentrated nitric acid	3
Water	3
Nitric acid	1
Hydrochloric acid	1
Water	8

The etching is carried out either by swabbing the surface with cotton wool or by immersing the specimen in the etching solution until a good definition of the structure is obtained. The specimen should then be washed in water, preferably hot, followed by rinsing with acetone or alcohol (industrial spirit) and dried in a current of air. If specimens are to be preserved, a coating of thin oil or colourless lacquer is of advantage.

(*Continued from page* 2)

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